STANDARDS DEVELOPMENT BRANCH OMOE
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REPORT NO. 2

REMOTE SENSING FOR THE MINISTRY OF THE ENVIRONMENT

"PROPOSED SCHEDULES FOR TASK 1 AND TASK 2"

prepared by
MOE's Remote Sensing Committee

April, 1981

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Report no. 2 remote sensing for the ministry of the environment : "proposed schedules for task 1 and task 2".

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Ontario

Ministry
of the
Environment

135 St. Clair Avenue West
Suite 100
Toronto, Ontario
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April 28, 1981

MEMORANDUM

TO: Mr. W. Bidell,
Assistant Deputy Minister,
Regional Operations and
Laboratories Division.

FROM: David W. Dalman,
Chairman,
Remote Sensing Committee.

SUBJECT: REPORT NO. 2 "PROPOSED SCHEDULES FOR TASK 1 AND TASK 2"

As requested at our meeting on 81 02 11, the Remote Sensing Committee held a series of meetings to prepare schedules of cost and effort for completing Task 1 and Task 2. The attached report presents the schedules.

Task 1 and Task 2 will provide a case study, a catalogue of data requirements and a catalogue of MOE's remote sensing experiences and capabilities. Collectively, these will provide the necessary background information to assess the contribution which remote sensing technology can make to the Ministry of the Environment's activities and provide a basis for considering organizational needs to effectively implement remote sensing techniques. In addition, it is expected that this information will be valuable for making decisions concerned with maintaining or improving present levels of service using remote sensing technology, particularly when faced with increasing constraints.

The Remote Sensing Committee estimates that to complete Task 1 and Task 2 concurrently, approximately 2 man years and approximately $3000 will be required. These cost estimates do not include salaries and support costs.

The implementation of this report was designed to be flexible. A variety of options are available for completing the task either internally or external to MOE, or a combination of both. However, the Remote Sensing Committee recommends that:

1. Task 1 and Task 2 be carried out concurrently according to this report;

2. Task 1 and Task 2 be completed using MOE staff;

3. One MOE staff member be engaged full time for approximately 1 year to complete the tasks and be provided with expenses and the necessary resources to employ one assistant; and

4. An Advisory Committee be formed using representatives from Head Office Branches, Regional Operations and other Ministries to meet as required.

It was noted by Mr. A. Castel during a meeting of MOE's Policy Committee, 81 04 22, that some of Task 2 may have been completed by MOE in 1973 during the formation of the Ontario Centre for Remote Sensing. I have established that this information will not affect our estimates for Task 2 as it is out-dated and contains insufficient detail. However, the information will be useful for documenting MOE's experience with remote sensing.

We would be pleased to discuss this report with you. If we can be of further assistance, please do not hesitate to contact us.

David W. Dalman

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REPORT NO. 2

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"PROPOSED SCHEDULES FOR TASK 1 AND TASK 2"

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April, 1981

SUMMARY

In January, 1981, MOE's Remote Sensing Committee prepared a Study Outline, "Remote Sensing for the Ministry of the Environment", for considering the utility of remote sensing techniques to MOE's programs. The Study Outline was accepted in principle and Mr. Bidell requested that detailed schedules be prepared for the two tasks which are suitable for immediate implementation. The two tasks are:

1. Apply existing remote sensing techniques to an on-going MOE activity (case study); and

2. Review present situation for using remote sensing in MOE.

This report, prepared by MOE's Remote Sensing Committee, presents detailed estimates of cost and effort to complete Task 1 and Task 2.

For Task 1 (case study) the Committee recommends that monitoring the Beardmore Industrial Waste Disposal Site be used to evaluate the application of existing remote sensing techniques to an on-going MOE activity. It is estimated that the case study will cost approximately $1500 and require 72 man/days over a period of 31 weeks to complete. The Committee estimates that the cost for Task 2 will be approximately $1200 and require 319 man/days over a period of 59 weeks to complete.

Therefore, to complete Task 1 and Task 2 according to the Study Outline and this report, the costs and effort required are estimated to be approximately $3,000.00 and 2 man/years. These cost estimates do not include salaries or support costs .

The completion of Task 1 and Task 2 will provide the necessary background information to assess the contribution which remote sensing can make to MOE's activities and provide a basis for considering organizational needs to effectively implement remote sensing techniques. In addition, it is expected that this information will be valuable for making decisions concerned with maintaining or improving present levels of service using remote sensing technology, particularly when faced with increasing constraints.

The implementation of this report is designed to be flexible. However, the Remote Sensing Committee recommends that:

1. Task 1 and Task 2 be carried out concurrently according to this report;
2. Task 1 and Task 2 be completed using MOE staff;
3. One MOE staff member be engaged full-time for approximately 1 year to complete the tasks and be provided with expenses and the necessary resources to employ one assistant; and,
4. An Advisory Committee be formed using representatives from Head Office Branches, Regional Operations and other Ministries to meet as required.

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INTRODUCTION:

In January, 1981, MOE's Remote Sensing Committee prepared a Study Outline, "Remote Sensing for the Ministry of the Environment", for consideration by Mr. W. Bidell, Assistant Deputy Minister, Regional Operations and Laboratories Division. Mr. Bidell accepted the Study Outline in principle and requested that the Remote Sensing Committee meet again to prepare detailed schedules for cost and effort required to:

1. Conduct a case study applying remote sensing techniques to one MOE project (Task 1); and

2. to survey and catalogue MOE's program requirements and remote sensing capabilities (Task 2).

The following report presents detailed schedules of cost and effort required to complete Task 1 and Task 2.

TASK 1: REMOTE SENSING CASE STUDY

INTRODUCTION:

The purpose of Task 1 is to demonstrate the capabilities of operational remote sensing techniques for one MOE project and to assess the ability of the Ministry of the Environment to implement these techniques. As stated in the Study Outline (81 01), this task requires a case study on applying operational remote sensing techniques to an on-going MOE program. Then, introduce remote sensing to this area, if the results are favourable.

SELECTION OF A CASE STUDY:

The possibilities considered by the Remote Sensing Committee for a case study included monitoring of municipal or industrial landfill sites and transfer stations, major industrial effluent discharges, air pollution problem areas, and sources of chemical contamination of groundwater. The criteria used for selecting the project included the following:

- proven operational remote sensing capabilities must be available within MOE;
- MOE program of common concern to all Regions;
- high level of public and MOE concern;
- readily available site(s) for case study;
- MOE should be aware of the environmental problem;
- the project should be on-going or previously examined by MOE, to facilitate cost comparisons;
- the project should be capable of full study within 6-8 months.

The Committee generally agreed that the concerns which best meet the purpose and criteria for the project, are monitoring major industrial effluent discharges and monitoring industrial waste disposal sites.

Recommendation: Monitoring industrial waste disposal sites is recommended by the Committee due to the greater level of interest in and requests for this type of remote sensing application and a greater possibility for obtaining data for cost comparisons.

SITE SELECTION:

At least three possible sites are available for monitoring

industrial waste disposal using remote sensing techniques. These include:

1. Beardmore (Division of Canada Packers) disposal site, Halton Hills, Ontario
2. Walker Brothers Site in St. Catharines, Ontario
3. A sample (three sites) in Central and/or West-Central Regions identified in the Industrial Waste Site Identification Study.

The Committee believes that the selected site should be close to Toronto to minimize travel and should provide the maximum opportunity for demonstrating the utility of remote sensing techniques. Therefore, the site should have a variety of problems, both existing and potential, to which remote sensing techniques can be applied. In addition, MOE should clearly benefit as a result of information generated in this case study.

Recommendation: The Beardmore site best meets the Committee's criteria and is recommended for the remote sensing case study. However, due to the similar size of the sites and their proximity to Toronto, all sites are in the same range of costs.

SUMMARY OF SCHEDULES FOR TASK 1:

Appendix 1 presents the schedules of cost and effort along with a detailed method and flow chart for Task 1. It is estimated that a case study using the Beardmore industrial waste disposal site will cost approximately $1,415.00 and require 54 man/days to complete. In addition, approximately 18 man/days of Regional Office staff time will be required in support of the case study (Refer to Table 1). The total duration of the project will be approximately 31 weeks. These cost estimates do not include salaries or support costs.

TASK 2: REVIEW REMOTE SENSING SITUATION

INTRODUCTION:

The purpose of Task 2 is to provide a basis for making decisions concerning the application of remote sensing to MOE's programs and to implement suitable remote sensing techniques throughout the Ministry. To fulfill this purpose, the Study Outline (Pages 13 and 15) identified twelve activities that can be grouped into three parts for the preparation of detailed procedures, schedules and estimates. These parts are:

INVENTORY:

1. Survey technical requirements of MOE programs;
2. Survey and catalogue existing MOE utilization, capabilities and capacities for using remote sensing techniques;
3. Analyze and document previous remote sensing experiences of MOE;

EVALUATION:

4. Match existing requirements with existing capabilites;
5. Identify potential benefits and costs;

IMPLEMENTATION:

6. Re-affirm existing uses of remote sensing techniques;

7. Prepare guidelines for basic applications of remote sensing techniques;
8. Introduce additional under-utilized applications to achieve the basic level of use;
9. Identify any additional operational remote sensing techniques;
10. Develop technical procedures for utilization of remote sensing techniques to the operational level;
11. Assess organizational needs; and
12. Implement remote sensing to full capabilities at MOE.

The inventory, evaluation and implementation activities are interdependent. The experience at MTC indicates that the inventory is a pre-requisite to the subsequent activities and, to a very large extent, affects the costs and effort required to complete the subsequent activities. Consequently detailed procedures and schedules of costs and effort are provided only for the inventory activities. However, to provide some indication, of cost and effort, an estimate is attempted for the evaluation activities.

Upon completion of the evaluation, a decision is required on whether to proceed with implementing beneficial applications of remote sensing. Also, at this time it will be possible to prepare reliable estimates for costs and effort to implement the results of Task 2.

SUMMARY OF TASK 2:

Appendix 2 presents the analysis of cost and effort along with a detailed method and flow chart for the inventory and evaluation activities for Task 2. Appendix 3 contains an example of a questionnaire which could be used for the surveys.

It is estimated that the cost for the inventory and evaluation would be approximately $1,200.00. This permits one visit to each Region to follow-up the results of the surveys. It is also estimated that approximately 292 man/days will be required for the Study Team to complete the inventory and evaluation. An additional 27 man/days of Regional and Head Office staff time would be required in support of Task 2. Approximately, a 59 week period would be required to complete the inventory and evaluation activities. If suitably compiled information or more efficient means of collecting information are identified, some savings in man/days may be possible. These cost estimates do not include salaries or support costs.

EXPECTED RESULTS FOR TASK 1 AND TASK 2:

Task 1 and Task 2 will provide a case study, a catalogue of data requirements and a catalogue of MOE's remote sensing experiences and capabilities. Collectively, these will provide the necessary background information to determine what remote sensing can do for the Ministry of the Environment and provide a basis for considering organizational needs to effectively implement remote sensing techniques. Completion of Task 1 and Task 2 will also assist managers in identifying potential areas for remote sensing research.

Case Study:

The case study will demonstrate the capabilities and identify the limitations for using remote sensing techniques (aerial photography) to monitor industrial waste disposal sites. Costs and benefits will be evaluated and compared to present methods of monitoring

and some of the potential difficulties in implementing remote sensing on a routine basis for monitoring industrial waste disposal sites will be identified.

Catalogue of Data Requirements:

The catalogue of MOE's data requirements will enable the identification of opportunities for using remote sensing techniques, identify areas for potential remote sensing research and provide a basis for assessing the utility of new or unproven remote sensors.

Catalogue of Experiences and Capabilities:

The catalogue of MOE's remote sensing experiences and capabilities will ensure that proven applications of remote sensing techniques to MOE's activities are identified. This will help to avoid duplication and facilitate exchange of this experience among all MOE Branches and Regions.

Cataloguing MOE's remote sensing capabilities will assist in identifying under-utilized applications and provide a basis for assessing organizational needs. In addition, some of the benefits and costs of using remote sensing techniques for MOE's activities will be assessed to identify effective and efficient remote sensing applications.

It is expected that upon completion of Task 1 and Task 2, managers will know what contribution operational remote sensing technology can make to MOE's activities. This information will be valuable for making decisions concerned with maintaining or improving present levels of service, particularly when faced with increasing constraints.

CONSIDERATIONS FOR IMPLEMENTING TASK 1 AND TASK 2:

First, it is important to emphasize that the Committee has made estimates of effort and costs for completing Task 1 and Task 2. The Committee is confident of the estimates for Task 1. However, there is less control over Task 2 and difficulties in collecting information may be encountered. These difficulties could result primarily in increases in time due to availability of staff during the field season, and suitable mechanisms for collecting the information. In this situation, the estimates could be low. Alternatively, a source of data may be discovered which would expedite the surveys. In this situation, the estimates could be high.

Second, there is flexibility in how the tasks can be implemented. Some activities can be performed independently without reference to the particular task. It may also be possible to carry out the tasks sequentially rather than concurrently. However, this may not be advisable.

Third, there is considerable choice in assigning the work required to complete Task 1 and Task 2. For example, the tasks could be completed internally by MOE staff or externally by the Ontario Government's experts at OCRS, or by universities or by consultants. Combinations are also possible. For example MOE staff could facilitate data collection, but compilation and analysis could be completed externally.

In addition, there are a variety of possibilities for completing the tasks using MOE personnel. For example, an "Advisory Committee" with experts from each Head Office

Branch could be formed to collect the information and oversee the compilation and analysis and the case study. Also, one MOE group or individual could be given responsibility to complete the tasks using the Study Outline and this report as terms of reference.

As a guideline, it is preferrable that those who carry out the tasks be familiar with remote sensing techniques and have an overview of MOE's program requirements. These characteristics will facilitate information collection and maintain a favourable bias towards MOE's needs.

Finally, a summary of costs and effort can be produced as follows:

	Expenses	Study Team		Additional Manpower		
Task 1	$1,415.00	54	+	18 (Regions)	=	72
Task 2	$1,200.00	292	+	27 (Head Office and Regions)	=	319
Total	$2,615.00	346 man/days	+	45 man/days	=	391 man/days

The summary indicates that approximately 2 man/years and $3,000.00 will be required to complete Task 1 and Task 2. If the tasks were completed sequentially, it would take one individual approximately two years to complete the tasks. Alternatively, two individuals would be required to complete the tasks concurrently in one year. To reduce the manpower demand on MOE, a person on contract could be employed to assist one MOE staff member, or a student assistant could be hired under the Experience Program and/or through a University Co-operative Program.

RECOMMENDATIONS:

The Remote Sensing Committee feels that it is to the advantage of MOE to carry out Task 1 and Task 2 using primarily MOE staff. In addition, these tasks should proceed concurrently as recommended in the Study Outline. Therefore, it is recommended that:

1. Task 1 and Task 2 be carried out concurrently according to this report;
2. Task 1 and Task 2 be completed using MOE staff;
3. One MOE staff member be engaged full-time for approximately one year to complete the tasks and be provided with expenses and the necessary resources to employ one assistant; and
4. An Advisory Committee be formed using representatives from Head Office Branches, Regional Operations and other Ministries to meet as required.

APPENDIX 1

DETAILED SCHEDULES FOR TASK 1

TASK 1: CASE STUDY

The purpose of this case study is to demonstrate the capabilities of operational remote sensing techniques for monitoring industrial waste disposal sites.

OBJECTIVES FOR CASE STUDY:

1. To identify the present characteristics and use of the site;
2. To identify any potential environmental concerns related to the site;
3. To compare the costs and benefits of collecting information using remote sensing techniques with conventional methods; and,
4. To identify any potential problems for MOE in implementing remote sensing techniques for this application.

METHOD:

The following activities are required to complete the case study:

1. Identify the data requirements of the Ministry of the Environment for the project selected.

2. Identify the potential costs and benefits of using remote sensing techniques to collect this data.

3. Discuss project with field staff.

4. Acquire aerial photographic coverage* of the site;
   (a) archival photography - from existing photography (various sources)
   (b) up-to-date photography - to be obtained by MOE
   - oblique photography using colour and colour infrared films in spring and mid-summer.

5. Interpret photography acquired to provide a chronological description of the site and an interpolation of conditions between the years in which the photography was flown. A series of overlays will be produced to depict the site conditions and also the changes. The following items are the minimum that can be provided:

   (a) spatial extent of site
   (b) type of use
   (c) site activities
   (d) materials being disposed
   (e) volume of waste deposited
   (f) site conditions and potential environmental concerns (eg. surface run-off, leachates, vegetation stress etc.).

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* All aerial photographic coverage will be stereoscopic, where available. This is an operational requirement in order to maximize the capabilities of this remote sensing technique. Additional details and up-to-date measurements are available using vertical metric photography. However, for the purposes of this case study, this capability can be demonstrated using archival photography.

6. Conduct selective and limited field investigation to verify observations.

7. Provide information to field staff and discuss findings with them.

8. Evaluate the capabilities of remote sensing techniques and calculate the actual costs and benefits of using remote sensing techniques.

9. Determine the implications for MOE of implementing remote sensing techniques for this application.

10. Prepare final report.

11. Develop guidelines for implementing remote sensing techniques for monitoring industrial waste disposal sites.

TABLE 1
TASK 1

ESTIMATE OF COST AND EFFORT

Activity	Man/Days		Duration	COST	
	Study Team	Region		Materials/Travel	
1. Identify data requirements	2	2	1 week		
2. Identify potential costs and benefits	2	1	2 weeks		
3. Discuss with field staff	1	1	1 week		$30.00
4. Acquire and interpret archival aerial photography	6	2	6 weeks	$300.00	
5. Acquire and interpret remotely sensed data					
. colour and colour infrared aerial photography	20	2	18 weeks	$800.00	
6. Field check	2	2	1 week		$60.00
7. Discuss with field staff	1	1	1 week		$30.00
8. Calculate actual costs and benefits	1				
9. Determine implications for MOE	1	1	1 week		$30.00
10. Prepare final report	12	4	6 weeks		
11. Develop guidelines	1				
12. Contingency	5	2		$150.00	$15.00
TOTAL	54	18		$1250.00	$165.00

FIGURE 1

DURATION FOR TASK 1

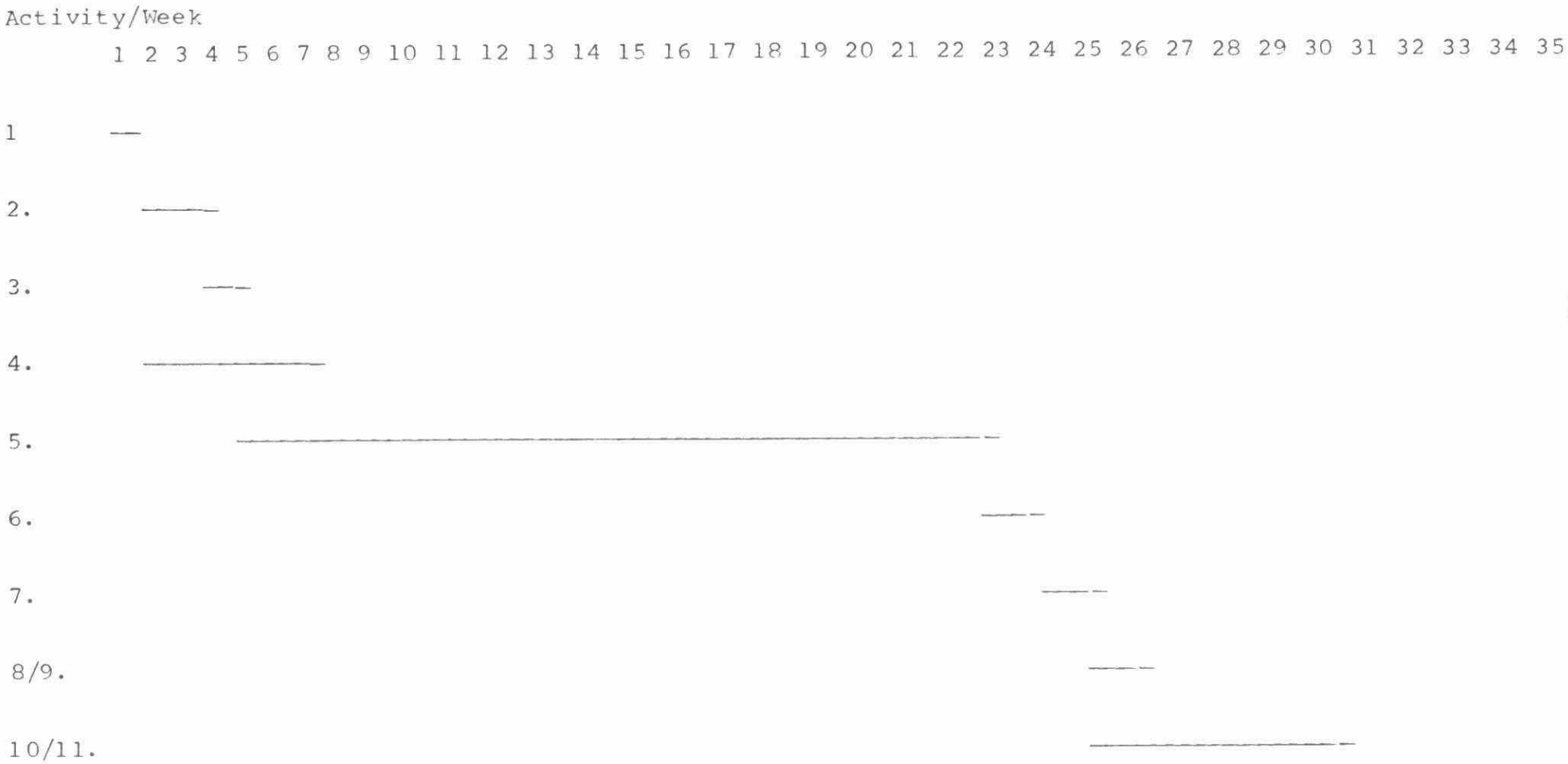
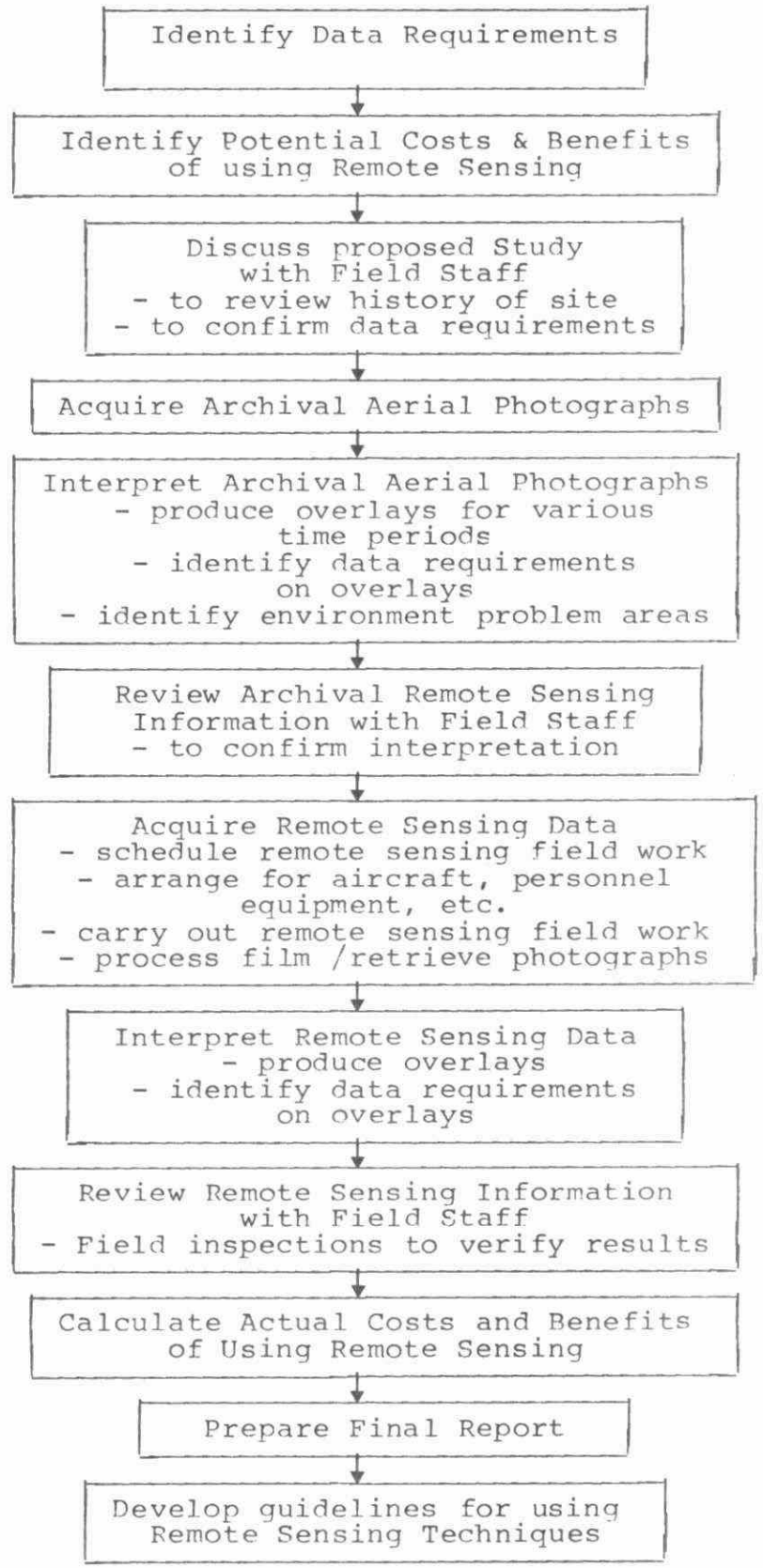


FIGURE 2

FLOW CHART FOR TASK 1

MONITORING INDUSTRIAL WASTE DISPOSAL SITES


Identify Data Requirements
Identify Potential Costs & Benefits of using Remote Sensing
Discuss proposed Study with Field Staff - to review history of site - to confirm data requirements
Acquire Archival Aerial Photographs
Interpret Archival Aerial Photographs - produce overlays for various time periods - identify data requirements on overlays - identify environment problem areas
Review Archival Remote Sensing Information with Field Staff - to confirm interpretation
Acquire Remote Sensing Data - schedule remote sensing field work - arrange for aircraft, personnel equipment, etc. - carry out remote sensing field work - process film /retrieve photographs
Interpret Remote Sensing Data - produce overlays - identify data requirements on overlays
Review Remote Sensing Information with Field Staff - Field inspections to verify results
Calculate Actual Costs and Benefits of Using Remote Sensing
Prepare Final Report
Develop guidelines for using Remote Sensing Techniques

APPENDIX 2

DETAILED SCHEDULES FOR TASK 2

TASK 2: Review Remote Sensing Situation

The purpose of Task 2 is to provide a basis for making decisions concerning the application of remote sensing to MOE's programs.

OBJECTIVES FOR TASK 2:

INVENTORY:

1. To survey the technical requirements of MOE's organizational units;
2. To compile and catalogue this information;
3. To survey the existing degree of remote sensing utilization and MOE's capabilities and capacities;
4. To compile and catalogue this information;
5. To analyze and document MOE's previous remote sensing experience;

EVALUATION;

6. To match existing requirements with existing capabilities;
7. To identify potential costs and benefits.

METHOD:

The following activities are required to complete Task 2:

INVENTORY:

1. Develop data collection forms to be used in surveys;
   a) identify priority of programs and develop list of organizational units;

b) design form and prepare instructions to survey MOE's technical requirements and remote sensing utilization;
c) Select trial programs and draft required memoranda;
d) conduct trial use of forms and instructions with Central and West-Central Region;
e) refine and finalize forms;
f) design tabulation forms to record and compile results of survey;
g) conduct trial use of tabulation forms;
h) refine and finalize tabulation forms.

2. Prepare memorandum on behalf of Senior Management to request co-operation in survey;
3. Distribute forms to various organizational units;
4. Respond to enquiries from recipients of forms;
5. Analyze and tabulate information received from organizational units;
6. Follow-up and clarify responses;
7. Identify organizational units with previous and potential remote sensing experience;
8. Contact organizational units and document remote sensing experiences;
9. Compile, analyze and document information from steps 5, 6, and 8;
10. Document successes and failures of remote sensing applications;
11. Prepare report;

EVALUATION:

12. Review results of Part 1 and design detailed methodology for Part 2;
13. Match existing requirements with existing remote sensing capabilities and capacities of MOE;
14. Identify potential benefits and costs of using remote sensing techniques.
15. Prepare report.

TABLE 2

TASK 2

ESTIMATE OF COST AND EFFORT

ACTIVITY	MAN/DAYS STUDY TEAM	REGIONAL & HEAD OFFICE	DUPATION	TRAVEL COST
PART 1				
1. Develop & Test Survey Methods	30	3	10 weeks	
2. Prepare memoranda	1		1 week	
3. Distribute forms	1		1 week	
4. Respond to Enquiries	4	2	4 weeks	
5. Analyze & Tabulate Information	60		12 weeks	
6. Follow-up to clarify information	6	6	4 weeks	
7. Identify units with remote sensing experience	5		1 week	
8. Collect data on remote sensing experience	40	16	12 weeks	$1,200.00
9. Compilation & Analysis	15		3 weeks	
10. Document remote sensing experience	50		12 weeks	
11. Prepare report				
PART 2				
12. Review results and design methodology	15		3 weeks	
13. Match requirements/ capabilities	20		4 weeks	
14. Identify potential benefits and costs	30		6 weeks	
15. Prepare report	20	—	4 weeks	
TOTAL	292	27		$1,200.00

DUPATION FOR TASK 2

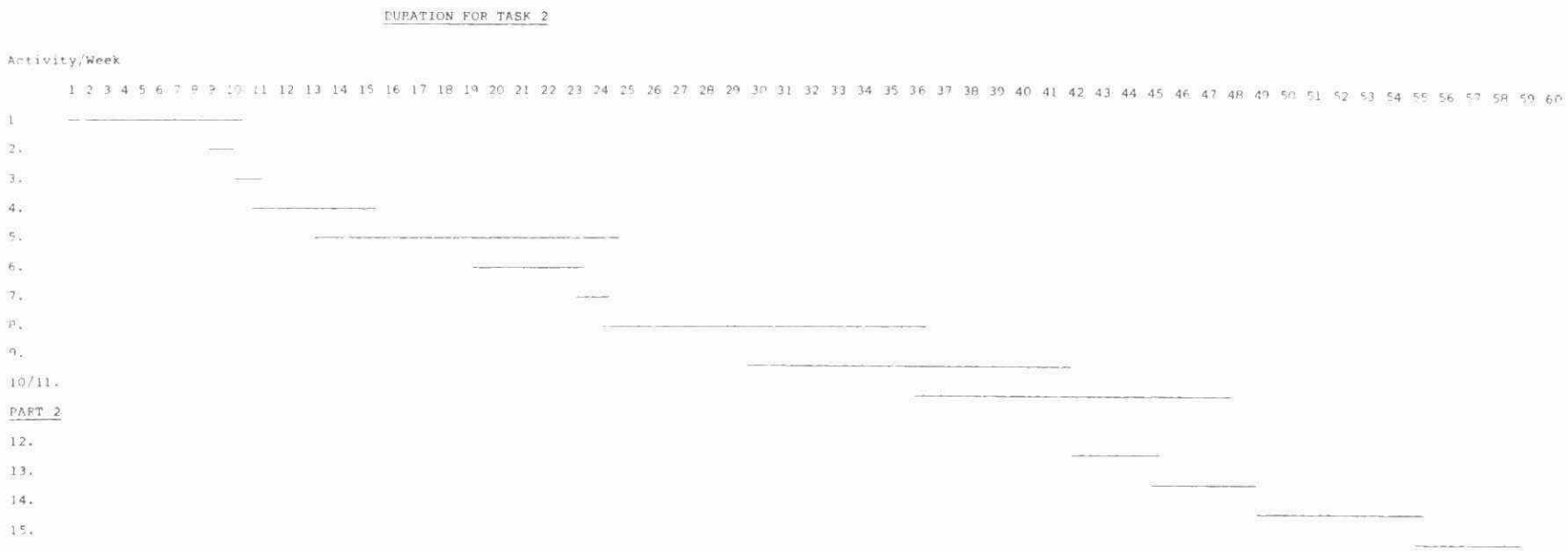
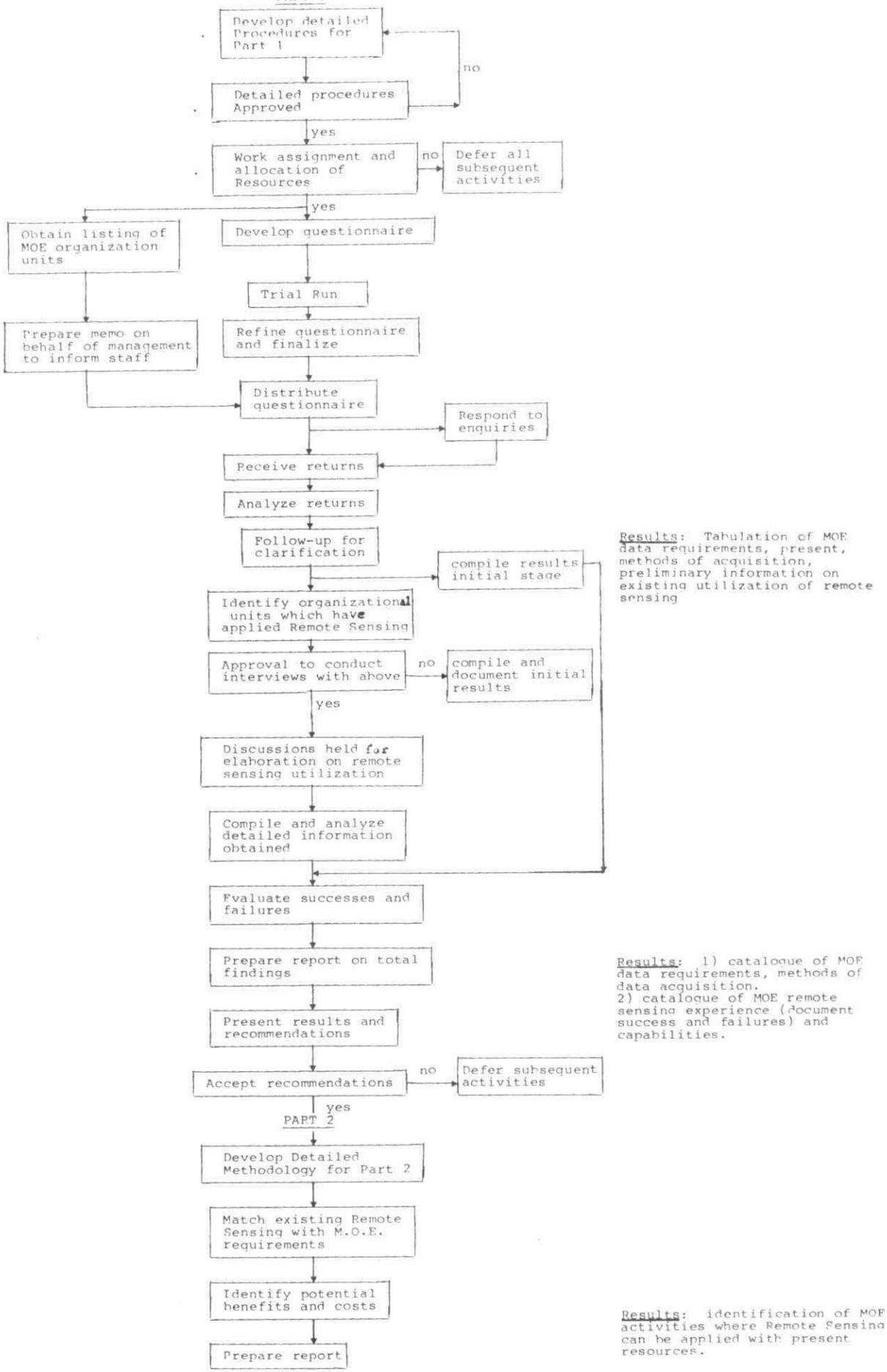


FIGURE 3

FIGURE 4

FLOW CHART FOR TASK 2, PARTS 1 AND 2


PART 1
Develop detailed Procedures for Part 1
no
Detailed procedures Approved
yes
Work assignment and allocation of Resources
no
Defer all subsequent activities
yes
Obtain listing of MOE organization units
Develop questionnaire
Trial Run
Prepare memo on behalf of management to inform staff
Refine questionnaire and finalize
Distribute questionnaire
Respond to enquiries
Receive returns
Analyze returns
Follow-up for clarification
compile results initial stage
Results: Tabulation of MOE data requirements, present, methods of acquisition, preliminary information on existing utilization of remote sensing
Identify organizational units which have applied Remote Sensing
Approval to conduct interviews with above
no
compile and document initial results
yes
Discussions held for elaboration on remote sensing utilization
Compile and analyze detailed information obtained
Evaluate successes and failures
Prepare report on total findings
Results: 1) catalogue of MOE data requirements, methods of data acquisition.
2) catalogue of MOE remote sensing experience (document success and failures) and capabilities.
Present results and recommendations
Accept recommendations
no
Defer subsequent activities
yes
PART 2
Develop Detailed Methodology for Part 2
Match existing Remote Sensing with M.O.E. requirements
Identify potential benefits and costs
Prepare report
Results: identification of MOE activities where Remote Sensing can be applied with present resources.

APPENDIX 3

EXAMPLE OF QUESTIONNAIRE

EXAMPLE OF QUESTIONNAIRE TO BE SENT TO EACH ORGANIZATIONAL UNIT

PROGRAM: WASTE MANAGEMENT
SUB PROGRAM: HAULED LIQUID INDUSTRIAL WASTE
Activity: Disposal

Item: Leachate	Existing	Prefered
A. Data Requirements		
1. Inventory of objects/features/conditions		
2. Detecting changes in objects/features/conditions		
3. Minimum size to be observed		
4. Minimum change to be observed		
5. When is above data required		
B. Data Collected		
1. How collected		
2. When: time of day month		
3. How Often		
4. Collected by:		
C. Data Recording & Presentation		
1. What is used?		
2. How?		
D. Remote Sensing Utilization	check	
1. Never used in this activity	( )	
2. Has been used. Results were		
(a) successful	( )	
(b) partially successful	( )	
(c) unsuccessful	( )	
3. Presently in use		
(a) as standard procedure	( )	
(b) occasionally	( )	
(c) by whom		
(d) equipment used		
(e) support services from		

completed by: Name _____

Organized Unit _____ Date _____

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